

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G02B 5/30, G02F 1/1335	A1	(11) International Publication Number: WO 97/01780 (43) International Publication Date: 16 January 1997 (16.01.97)
---	----	---

(21) International Application Number: PCT/US96/07080

(22) International Filing Date: 16 May 1996 (16.05.96)

(30) Priority Data:
08/494,978 26 June 1995 (26.06.95) US

(71) Applicant: MINNESOTA MINING AND MANUFACTURING COMPANY [US/US]; 3M Center, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).

(72) Inventors: WILLETT, Stephen, J.; P.O. Box 33427, Saint Paul, MN 55133-3427 (US). WEBER, Michael, F.; P.O. Box 33427, Saint Paul, MN 55133-3427 (US). OUDERKIRK, Andrew, J.; P.O. Box 33427, Saint Paul, MN 55133-3427 (US). JONZA, James, M.; P.O. Box 33427, Saint Paul, MN 55133-3427 (US).

(74) Agents: LEVINSON, Eric, D. et al.; Minnesota Mining and Manufacturing Company, Office of Intellectual Property Counsel, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

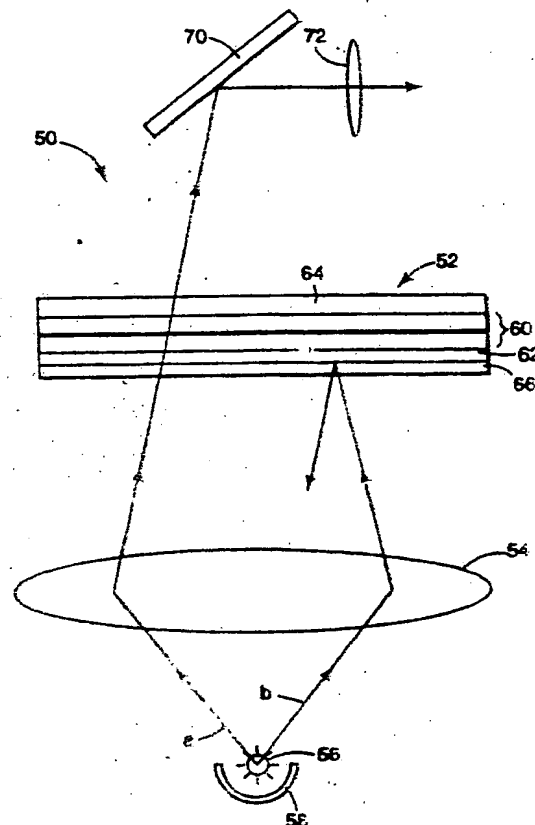
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: LIQUID CRYSTAL DISPLAY PROJECTION SYSTEM USING MULTILAYER OPTICAL FILM POLARIZERS

(57) Abstract:

A liquid crystal display (LCD) projection system (50) including a projection panel (52), a light source (56), and a reflector (58). The projection panel includes an LCD (60) and a polarizer (64) on one side of the LCD and a reflective polarizer (62) on the other side. The reflective polarizer is a multilayer stack of pairs (44) of adjacent material layers (41, 43). Each of the layer pairs exhibits a refractive index difference between the adjacent layers in a first direction in the plane of the reflective polarizer and exhibits essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction. A quarter-wave plate (66) is secured to the reflective polarizer. Light rays from the light source either pass through the reflective polarizer and on to the LCD, or are reflected back toward the light source, depending on their polarization. Light which is reflected by the reflective polarizer is reflected by the reflector back toward the LCD again. The use of the quarter-wave plate and the reflector help to recycle what would typically be regarded as wasted light, while at the same time reducing heat build-up within the LCD.



We claim:

1. A liquid crystal display projection system (10), comprising:
a projection panel (12), comprising:
5 a liquid crystal display (20); and
a pair of dichroic polarizers (22, 24), wherein one polarizer is
provided adjacent each side of the display;
a light source (16) for directing light toward the panel; and
a reflective prepolarizer (26) comprising a multilayer optical film (36)
10 provided between the light source and the dichroic polarizer
facing the light source, the film comprising a multilayered stack
or pairs (44) of adjacent material layers, each of the layer pairs
exhibiting a refractive index difference between the adjacent
layers (41, 43) in a first direction in the plane of the reflective
15 prepolarizer and exhibiting essentially no refractive index
difference between adjacent layers in a second direction in the
plane of the reflective prepolarizer and orthogonal to the first
direction.
2. The system of claim 1, wherein the film comprises a plurality of
20 alternating layers of semi-crystalline naphthalene dicarboxylic acid polyesters and
another polymer.
3. The system of claim 1, further comprising:
25 a quarter-wave plate (28) provided between the light source and the
reflective prepolarizer; and
a reflector (18) provided on the side of the light source opposite the
panel.
4. The system of claim 1, further comprising a reflective polarizer provided
30 between the liquid crystal display and the dichroic polarizer on the side of the liquid

crystal display opposite the light source, the reflective polarizer comprising a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction.

5. A liquid crystal display projection system (50), comprising:
a projection panel (52), comprising:

a liquid crystal display (60);
a first polarizer (64) provided on one side of the display; and
a second polarizer (62), which is a reflective polarizer, provided on the other side of the display, wherein the second polarizer comprises a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction; and
a light source (56) for directing light toward the second polarizer.

6. The system of claim 5, further comprising a third polarizer, which is a reflective polarizer, provided between the first polarizer and the liquid crystal display, the third polarizer comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the third polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the third polarizer and orthogonal to the first direction.

7. The system of claim 5, wherein the first polarizer is a reflective polarizer comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the first polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the first polarizer and orthogonal to the first direction.

8. The system of claim 7, further comprising:
a quarter-wave plate (66) provided between the light source and the second polarizer; and
a reflector (58) provided on the side of the light source opposite the panel.

9. A liquid crystal panel, comprising:
a liquid crystal display (60);
a first polarizer (64) secured to one side of the display;
a second polarizer (62), which is a reflective polarizer, secured to the other side of the display, wherein the second polarizer comprises a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction; and
a quarter-wave plate (66) secured to the second polarizer.

10. An overhead projector (132), comprising, in order:
a projection lamp (122);
a converging lens (124);

a quarter-wave plate (126) secured to the converging lens; and
a reflecting polarizer (128) secured to the quarter-wave plate, the
reflecting polarizer comprising a multilayer optical film (36)
comprising a multilayered stack of pairs (44) of adjacent
material layers, each of the layer pairs exhibiting a refractive
index difference between the adjacent layers (41, 43) in a first
direction in the plane of the reflective polarizer and exhibiting
essentially no refractive index difference between adjacent layers
in a second direction in the plane of the reflective polarizer and
orthogonal to the first direction.

11. A liquid crystal display projection system (140), comprising in order:
an overhead projector (142);
an adapter panel (150) provided on the projector, the adapter panel
comprising a quarter-wave plate (144) and a reflecting polarizer
(146), the reflecting polarizer comprising a multilayer optical
film (36) comprising a multilayered stack of pairs (44) of
adjacent material layers, each of the layer pairs exhibiting a
refractive index difference between the adjacent layers (41, 43)
in a first direction in the plane of the reflective polarizer and
exhibiting essentially no refractive index difference between
adjacent layers in a second direction in the plane of the reflective
polarizer and orthogonal to the first direction; and
a liquid crystal display projection panel (148) provided on the adapter
panel, the projection panel comprising a liquid crystal display
and a pair of dichroic polarizers provided on opposite sides of
the display.